SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CXXXVI.] MAY, 1877. [PRICE FOURPENCE or 5s. per ann. post free.

Re GOVERNMENTAL METEROLOGY.

[As we have been informed that an opinion exists that the articles which have appeared in this Magazine upon Governmental Meteorology have been partly written for the purpose either of assisting the Meteorlogical Society in obtaining a grant from Government, or of preventing the Scottish Meteorological Society from obtaining one, we desire to state that the articles were not written on behalf of the Meteorological Society, and were not inspired by its Council or Fellows; in fact, the Meteorological Society was in no way connected with the articles, for which we alone are responsible. We may also add that we in no way desire to thwart the objects, or detract from the position of the Scottish Society, and are surprised that either inference has been drawn from the articles in question.—ED.]

EASTER AT THE SORBONNE.

THE pressure upon our space compels us to render our report of the papers read at this réunion shorter than usual, and shorter than we desire. We therefore proceed *in medias res* without further preface.

M. HÉBERT, of Limoges, President of the Meteorological Commission of Haute Vienne, gave a description, and exhibited a series, of charts illustrative of the weather of Western Europe during the exceptional winter of 1876-7, but owing to the short time allowed to each speaker he had only stated whence he had collected his data, and given what may be described as a chronicle of the weather when he was obliged to conclude. He has evidently a valuable collection of facts, and we hope on some future occasion to see his paper printed *in extenso*, and to lay his conclusions before our readers.

PROF. POUSSET, of Poitiers, reported briefly upon the rainfall of the Department of Vienne in 1876. He dwelt especially upon the differences in the *amount* of rain at the fifteen stations, although the *number of days* was nearly the same throughout the Department, and thence he drew the conclusion that the precipitation of rain is a general phenomenon, but that its amount is a local one. He held that the

amount of rain was dependent upon the nature of the soil. Prof. Pousset stated that, contrary to the generally received opinion, he found the rainfall least in the most wooded districts.

M. LE DR. DE PIETRA-SANTA, delegate from the Climatological Society of Algiers, gave an account of the results of an enquiry instituted by the care, and under the direction, of the three provinces of Algeria, in order to ascertain the importance and value of the Eucalyptus globulus in relation to public health.

Reports were received from fifty localities, where the aggregate number of blue gum trees is nearly one million.

The following are the principal conclusions :—

(1) It is is incontestably demonstrated that the Eucalyptus possesses sanitary influence.

(2) Wherever it has been extensively cultivated intermittent fever has been considerably decreased in intensity and in frequency.

(3) Marshy and uncultivated lands have thus been rendered healthy and quite transformed, both to the advantage of private interests and of Algerian colonization.

Similar results have been obtained in Corsica, where, thanks to the initiative and to the perseverance of a single man, Dr. Carlotti, President of the Ajaccio Agricultural Society, it is computed that at the end of this year there will be upwards of 600,000 plants of Eucalyptus in full growth.

M. PICHE, of Pau, gave a short description of a form of Meteorological Chart which he had found very useful in forecasting the weather for short periods. He also laid upon the table copies of an eight-page tract upon the subject, which, though in many respects resembling Admiral FitzRoy's Barometer Manual, yet differs so much from it, and is in many parts so instructive, that we hope to give a translation of it at an early date. As a specimen of the difference from what prevails in England, we may mention that in the South-West of France M. Piche states that when the barometer falls the weather is usually fine, when the barometer rises, the sky is usually overcast with wind and rain, or appearance of rain. But the fall of the barometer *announces* the advent of bad weather, although the weather remains fine as long as the barometer is low.

Prof. RAULIN, of Bordeaux, gave a *résumé* of the seasonal distribution of the rainfall in the Alps, from Vienna to Marseilles, and in Italy, based upon the records of about 250 stations, having a mean duration of 10 years. He did not enter upon any discussion of the total amounts, but directed attention to the seasonal distribution. Of these he pointed out four varieties which may be thus represented :—

Per Cent. of Total Annual Fall.

	Winter.	Spring.	Summer.	Autumn.
Type I.	16	25	**36**	23
II.	11	21	28	**40**
III.	15	**41**	11	33
IV.	**31**	20	10	**39**

On the northern slope of the Alps and in Germany, and even towards Carinthia and northern Istria, the maximum falls is in the summer (Type I.)

North of the valley of the Po, and on the northern French Alps, the maximum occurs in the autumn (Type II.)

South of the valley of the Po, and on the Alps of Dauphiné there are two maxima, a principal one in the spring, and a secondary one in the autumn (Type III.)

On the shores of the Mediterranean and of the Adriatic the distribution is almost exactly complementary to that on the northern Alps, for on these coasts the principal maximum is in the autumn, and a secondary one in the winter (Type IV.), so that along the coast of Provence, Liguria and Istria; that is to say, at the head of the Gulf of Genoa and of the Adriatic 70 per cent. of the entire annual amount of rain falls in the autumn and winter. In the discussion it was pointed out that the apparent seasonal distribution largely depended on the method adopted for the measurement of snow.

M. DE ROUVILLE, on behalf of Prof. VIGUIER, of Montpellier, explained a new theory of the formation of hail storms. The author considered that the only requisites for their formation are (1) the existence of beds of air of different temperatures (2) their lateral translation, and (3) the presence of mountains. He has been led to this conclusion, after long study, by noticing that the Mediterranean, although it gives rise to squalls and electric storms, does not usually send hailstorms over Southern France; and that the almost periodic hailstorms of that district come from the west, having previously passed over the Pyrennees and the Central Plateau. Hence it results, according to Prof. Viguier, that we must exclude from the theory of hailstorms all reference to small cyclones and electric phenomena, and regard solely the mechanical movements of the atmosphere and the effect of the inequalities of the soil.

At the final meeting, presided over by M. Waddington, the Minister of Public Instruction, the usual reports upon the works of the members of the learned societies of the Departments were read. We wish that some analogous encouragement were given to English investigators by the English Government; but it is useless to wish, and the only thing for British men of science to do is to work on, and rest satisfied with the approval of their own consciences. Why, the very notion of its being the official duty of a Cabinet minister to preside over a scientific meeting is enough to make an ordinary Englishman smile, though that smile only proves how slow we are to perceive and to recognise that we are being, and shall be, beaten in intellectual progress by our friends across the channel.

The whole of the addresses were most interesting, but we must only quote that portion of M. Blanchard's report which was devoted to meteorology:—"Meteorologists pursue their researches most zealously, some devoting themselves to the observation of current phenomena, others collecting, from all possible sources, the scattered records of the past, and subsequently deducing, by a multitude of comparisons, pre-

cise facts as to the climate of different countries. Prof. Raulin, of Bordeaux, undeterred by the immense labour, has exhausted all documents in order to determine rainfall of France, parts of Europe, Algeria and tropical countries. We know that the rainfall varies in different countries, as it varies also in different seasons. In some countries it is always raining; in others, where the total fall is still greater, it seems to be always fine, because the rain only falls for a short time, but then very heavily. The distribution of rainfall exercises a great influence upon both vegetable and animal life, and it is greatly to the interest of naturalists, engineers and agriculturists to study it carefully. Prof. Raulin has undertaken, on their behalf, an excessively laborious but eminently useful task. His work is the most extensive, and only complete one, upon the rainfall of France, and we owe our thanks to the Academy of Bordeaux, which has done itself honour by publishing it. The Committee have awarded a gold medal to Prof. Raulin.

"Last year we announced the approaching inauguration of the meteorogical observatory recently erected on the summit of the Puy-de-Dome. All being completed, the establishment provided with the necessary instruments, and observations ready to be commenced, the observatory was inaugurated on August 22nd, 1876. It was a fête day for Clermont and the surrounding district. Beholding some hundreds of *savants*, or friends of science, starting for the summit of the mountain, the more lowly inhabitants of Auvergne appeared to regard it as a triumph for their country. Better informed well-wishers had, without doubt, a similar opinion, but they also looked further, to the many questions relative to the physics of the globe, upon which light may be thrown by the observations to be made under these new and especially favourable conditions.

"The Meteorological Observatory of the Puy-de-Dôme is the work of Professor Alluard; it inspires a singular interest in those who reflect upon the exertions, the trouble and anxiety through which alone it has been completed. For many years meteorologists and physicists have declared that it was necessary to observe atmospheric changes at high elevations, but hitherto nothing has been done, except to furnish instruments (generally badly placed) to the monks of Mont St. Bernard and at some stations in the Alps.*

"The Professor of Clermont often watching the beautiful mountain so near to his town, and seeing it suddenly veiled from his sight, said, 'There is the place to study the formation of the clouds, the snow, and the rain; it is there that I should like to build my observatory.' Excellent idea, but its accomplishment seemed almost hopeless. Professor Alluard first spoke of the subject in 1869; he exerted himself to find supporters for his enterprise, and submitted the project to the Minister of Public Instruction.'

"M. Faye was instructed to examine the locality, and report. He was speedily convinced of the advantages which an observatory on the summit of the Puy-de-Dôme might offer, and urged the Minister not

* It would be unjust not to mention here, the efforts of General Nansouty to establish an observatory on the Picdu Midi.

to allow the scheme to be abandoned. In 1870, the Chamber of Deputies passed a vote for the cost of the buildings, and the work was commenced; but it proved much more expensive than had been expected, and was only completed by the liberal aid of the Conseil Generale of the Department.

"The ground being bought, the roads laid out, the plans decided upon, Professor Alluard has followed up the enterprise with all possible energy. The first stroke of the pick-axe led to a discovery of the highest interest to archæologists, namely, of the remains of an entirely forgotten but magnificent Roman temple, which yields fresh testimony to the love of gigantic works which prevailed among the conquerors of ancient Gaul. Everyone will respect these ruins as they pass to the platform whereon now stands the massive tower of the meteorological observatory, which dominates the vast plain of Limagne and the long chain of the Dômes. I do not give here either any description of the rooms, of the dwelling-house, or of the subway connecting the two, because it has already been given in many periodicals.

"Let it suffice to say, that the arrangements have been considered excellent, the fitting irreproachable, and the instruments as perfect as possible. The Mountain Observatory is in constant telegraphic communication with an observatory in the plain, so that momentary comparison can be made of the phenomena at two stations near together, yet differing nearly 5000 feet in altitude, comparisons which can hardly fail to lead to important results. May the observatory on the Puy-de-Dôme contribute, as we firmly believe it will, to throw light upon questions respecting the physics of the globe, which are important to the whole human race; but let us not forget that we owe it to Professor Alluard, who not only had the inspiration, but what is more rare, the perseverance to secure success.

"Gentlemen, while retracing the history of the observatory, we feel the shadow of a genius passing before our eyes. We are all reminded of Blaise Pascal and of the experiment whereby on this mountain was first definitely proved the weight of the atmosphere. His shade seems to come to encourage the observers on the summit. Pascal as a savant was full of sagacity and penetration, as a writer he was full of vigour and originality; he offers to our admiration the union of all the most brilliant mental qualifications, and remains a model for future generations."

It may interest our readers to know that while the Puy de Dôme was the first mountain on which the barometric pressure was shown to be less on the summit than at the base, the beautiful Tour St. Jacques, in the Rue de Rivoli, Paris, was the first building in which Pascal proved the diminution of pressure with elevation. Hence the peculiar appropriateness of the erection of his statue in the base of that very tower.

Those of our readers who are interested in the early history of meteorology may be glad to know where to find the account of the experiment on the Puy de Dôme. It is given in a remarkably pleasantly

and cleverly written letter faom M. Perrier, of Clermont, dated Sept. 22nd, 1648, which is printed in a small work published in Paris in 1698, entitled, "*Traitez de L'Equilibre des Liqueurs, et de la Pesanteur de la Masse de l'Air.* Contenant l'explication des causes de divers effets de la nature qui n'avoient point esté bien connus jusques-icy, & particulierement de ceux que l on avoit attribuez à l'horreur du Vuide." Par Monsieur Pascal.

SEVERE FROSTS, MAY 2ND–7TH, 1877.

To the Editor of the Meteorological Magazine.

SIR,—The minimum temperatures of the last six mornings have been as follow :—

Date.	Thermometer. In Stand. 4 ft. elevation.	Fully exposed on grass.
May 2nd	34°·9 ...	28°·8
,, 3rd	31 ·1 ...	25 ·0
,, 4th	28 ·8 ...	24 ·0
,, 5th	26 ·8 ...	20 ·4
,, 6th	28 ·4 ...	23 ·1
,, 7th	29 ·8 ...	22 ·8

Taking the mean temperature of the whole 24 hours, May 3rd was really the coldest of the series, the max being only 48°·8, and the mean 38°·2.

Cold E. and N.E. winds, bringing hoar frosts, and much dry, fine weather, were also the marked features of this same month last year. During the first 20 days of it we had no less than 14 frosts on the grass, and a rainfall only on one day (the 15th).

Your obedient servant,

W. F. DENNING, F.M.S.

Tyndale House, Ashley Down, Bristol,
May 7th, 1877.

SIR,—As I expect you will mention the very low night temperature during the past week in your next number of the *Meteorologieal Magazine* I send the following readings :—

Date.	Min. at 4 ft.	Date.	Min. at 4 ft.
May 1st ...	34°·8	May 5th ...	28°·8
,, 2nd ...	36 ·0	,, 6th ...	28 ·8
,, 3rd ...	34 ·0	,, 7th ...	32 ·8
,, 4th ...	28 ·0*	,, 8th ...	35 ·8

* At the Museum the min. at 4 ft. was 28·5, and the min. on grass 17°·9.

Belmont Villas, Leicester,
8th May, 1877.

H. B.

THE CLIMATES OF VARIOUS BRITISH COLONIES.

THE evening meeting of the Royal Colonial Institute was held on Tuesday, March 13th, his Grace the Duke of Manchester in the chair.

Amongst those present we noticed Dr. Risdon Bennett, F.R.S., President of the Royal College of Physicians; Dr. Sieveking, Dr. J. Langdon Down, Dr. Theodore Williams, Dr. Ord (Tasmania), Dr. Buchanan (New Zealand),

Dr. Haviland (Northampton), Mr. Henry Rhodes (British Columbia), Dr. Rae, Mr. Fung-Yee (Chinese Embassy), Mr. Youl, C.M.G., Mr. C. Brooke, F.R.S., Colonel Denison (Canada), Mr. Nind (Queensland), Mr. Alexander McArthur, M.P., Mr. Abraham Hyams (Jamaica), Mr. R. Chamberlaine (Jamaica), His Honour G. Trafford, Chief Justice of St. Vincent; Messrs. J. Campbell (Natal), J. Bruce (Cape of Good Hope), Andrew Stein (Cape of Good Hope), R. Ryall (Cape of Good Hope), R. H. Scott, F.R.S., James Bonwick (Tasmania), J. W. Russell (New Zealand), John Robb, Hugh Muir (Canada), and J. R. Carter (New Zealand).

The following paper was read by Mr. G. J. Symons, F.M.S. :—

ON THE CLIMATES OF THE VARIOUS BRITISH COLONIES.

When a speaker begins with an apology, it is usually found that no apology was needed. I will not, therefore, presume to apologise for the imperfections which appertain to the present paper, but I do ask two somewhat opposite favours. First, that you bear in mind the extreme difficulty of making the working and results of a strictly scientific subject comprehensible and interesting to those who have not previously given it their attention. That is the first request. The second is that all those who detect, or think that they detect, errors or mistakes in what I say, will take notes of them, and call attention to them in the discussion which will follow my remarks. I do not ask this at all in the spirit of a champion, but merely in the interests of accuracy and progress, for which I care infinitely more than for my own status or for my own opinions.

We must consider first what is meant by the word "climatology." Nuttall defines it as "An account of the different modifications relative to heat, wind, moisture, and other meteorological phenomena of the different regions of the earth." That is not bad for a dictionary, but we must go much further. And first as regards heat. Happily, throughout the British Empire, and also throughout the United States, there is no confusion as to thermometric scales. We all use the ordinary English or Fahrenheit's scale (although, by-the-by, Fahrenheit, as the name at once tells us, was not an Englishman, but a German). Two other points are necessary as regards temperature—(1) That the thermometers be everywhere similarly mounted, and (2) that they be read at the same hours of local time. As regards the first point, there is scarcely anything in common to the modes of exposure adopted at the Royal Observatory, Greenwich, and at the Kew Observatory of the Royal Society. With such an utterly discordant practice at home, we can hardly condemn with severity the fact that at many Colonial stations even more discordant methods prevail. The Meteorological Society has, however, decided that for all its stations absolutely similar instruments in absolutely similar conditions shall be used, and I have here a specimen of the Stevenson stand adopted by the Society. It contains four thermometers: a maximum to show the highest temperature in the shade, a minimum to show the lowest, a dry bulb to show at any time the true temperature of the air, and another thermometer with the bulb covered with moist muslin; the difference between the temperature shown by this and by the dry thermometer indicates the amount of moisture in the air. Although I am by no means certain that this is the best arrangement possible, and although I do not suppose that it is adapted for every climate, I am sure of this, that its establishment at all our Colonial observatories would be one great step in advance because it would give uniformity of observation, and without uniformity, comparisons are terribly misleading.

Dr. Neumayer, who was for some years in charge of the Melbourne Observatory, says, in the introduction to one of his excellent volumes, that the thermometer stand is "similar to that constructed by Lawson, save that it is placed upon a platform about five feet high, whereby the bulb of the thermometer is raised nearly ten feet from the ground; a precaution very much to be recommended in a country like this, where the soil assumes so high a temperature." I cannot understand this argument. It has been urged that what we require to know is the temperature of the layer of air which passes into people's lungs; hence we in England always put our thermometers between four and five feet above the soil. Dr. Neumayer says that a thermometer at that height is affected by the radiation

of heat from the hot ground. Probably: but so are the bodies of the colonists; so, to a less extent, is the air they breathe. By placing his thermometers at ten feet above the ground, Dr. Neumayer undoubtedly obtained lower temperatures during hot periods than that of the air breathed by the inhabitants. Mr. Todd, of Adelaide, whose name is familiar to all the members of this Institute, as that of the successful director of the great Central Australian telegraph, recognises this difficulty, in the Article contributed by him to "Harcus's Handbook of South Australia," and other directors of Colonial observatories have written to the same effect; but nothing has been done towards securing the precise similarity of the conditions under which the instruments are placed. Moreover, it is a singular fact, that amongst all the papers, books, and reports issued by the various Colonial Governments, which I have seen, there is not one which gives any engraving of the mounting of the instruments, or plan of the place where the observations are made.

The other point in respect of which uniformity of method is necessary, is the time of observation. It neither requires a moment's thought nor a diagram to tell anyone that it is usually hotter at midday than at midnight. Yet through this self-evident fact a large amount of confusion has arisen. I do not like taking up your time with what appear trivial details, and therefore before plunging into this subject, I should like to justify myself by saying that as the aggregate sum expended upon Meteorology in India and the British Colonies is probably considerably more than £20,000 per annum, the expenditure of the money to the best effect is not altogether unworthy of consideration; and moreover, that I believe that meteorological observations conducted upon strictly uniform methods would lead to results far exceeding, even in money value, the cost of the instruments, and brains necessary to obtain them. One more digression is suggested by the last remark. How is it to be accounted for that individuals and Governments are always more willing to pay for instruments than for brains? They will buy costly instruments, and by keeping down the number and salary of the observers, prevent the full value being got even out of the instruments they have bought.

Starting from midnight, the temperature falls until about 4 a.m., or half an hour after sunrise; it then rises rapidly, becomes hottest about 2 p.m., and then falls till sunrise next day. The lowest point is called the minimum, the highest is called the maximum, and the difference between the two the "daily range." Thus far all is easy and obvious. I now come to a point in which, I believe, there are few Colonial Observatory directors who have not done wrong by trying to do too well. I do not hesitate to mention this and other adverse facts, because, if I am wrong, I can easily be corrected, and if I am right, all who care more for science than for their own personal dignity will thank me for performing a generally thankless office. For the criticism of others I do not care one iota.

It is not of much use to know the highest temperature reached each day if we do not also know the lowest, and as it happens that half-way between the two is nearly the true mean temperature, it has become usual to indicate the temperature of different localities by their mean temperature. Unfortunately, there are several ways of ascertaining mean temperature:—(1) The arithmetical mean of the two extremes. As these extremes can be obtained by reading the maximum and minimum thermometers once daily, this is a very easy and simple method. (2) By reading the thermometer every hour, and taking the average of the 24 readings as the mean of the day, (3) By reading the thermometer two or more times a day and applying corrections for the supposed difference due to those being hotter or colder than the average of the 24. The second plan is undoubtedly the best, but it is too troublesome for general adoption. The third plan is only available where the second has previously been carried on for a long time in order to ascertain what the corrections are.

The essential feature in the comparison of different localities being, as I have said, that it must be with similar data, similarly observed and similarly reduced, it is greatly to be regretted that there is no uniformity in the systems adopted in the various Colonies; and worse still, I find that in some of them (Canada, for instance) various plans are adopted, some at some stations, others at others.

If the Directors of the various Colonial observatories cannot agree to universally adopt one system (which I think they ought to be required to do), it is at least desirable that all their publications should give the mean obtained by the first-mentioned method. That it is not perfect I freely admit, but as long as we rely upon the arithmetical mean of observed facts, and state precisely how the figures are obtained, we shall be providing ourselves with something definite, and our successors will have no difficulty in getting at the absolute truth from our approximations. I am glad to say that for several Colonies this method is adopted, for instance, in New South Wales, New Zealand, &c.

I do not like pointing out an evil without suggesting a remedy. In the present instance I offer two suggestions :—(1) That the attention of the Governments of the various Colonies be called to the fact, that there are scarcely any two of which the official records of the meteorology are strictly comparable, and that they be urged to arrange for a conference of the whole of the Directors, with instructions for them to discuss the method best adapted for universal adoption, and to bind themselves uniformly, universally, and rigidly to carry out the method recommended by the majority. The votes at the conference to be weighed proportionally to the number and equipment of the stations under the direction of each member of the congress. (2) Failing this, which would be the proper course, useful information might be obtained by stipulating that at every principal observatory a Stevenson's screen with the four usual thermometers be erected, and that the instruments be read at 9 a.m. and 9 p.m. daily, and the observations printed *in extenso*, with no corrections except for instrumental error. This would not cost £10 per station, even if freight be added to the cost of the apparatus.

There are many other points of divergent practice which render it impossible to compare accurately the records from the various Colonies, but as they are of less importance than those already named I will only mention one as an illustration. It is well known that on a clear night a grass plot cools down by radiation much more than does the air four feet above it. This radiation minimum is of great importance in connection with vegetation, especially as regards vines. In England we (whether wisely or not is very doubtful) measure this radiation by laying a thermometer on grass ; some of the Colonies follow our example, but at Adelaide it is laid upon raw wool, at Melbourne the thermometer is placed in the focus of a reflector, and so on.

In the year 1873, at the request of a member of our Council, Mr. S. W. Silver, I undertook the organization of a series of synchronous meteorological tables from as many as possible of the British Colonies. The directors of the Colonial observatories, with very few exceptions, agreed to furnish the necessary returns without any charge ; they have, since January, 1874, been tabulated under my supervision and published monthly in *The Colonies*. Although these records are affected by the causes for whose removal I have pleaded, it is impossible to deny that these monthly tables give a better survey of the climate of the British Empire than any others yet published ; thanks are therefore undoubtedly due to the proprietors of *The Colonies* for bearing the cost of their preparation and publication. Instead of occupying time by describing the nature of these tables, I have arranged that copies shall be placed in your hands ; and, as it would scarcely be decorous for me to praise my own work, and I do not see how to find fault with it, I leave these tables without further comment.

Another organisation requires notice—namely that of the Army Medical Department. It has 16 stations, besides those in the United Kingdom, viz., one each at Gibraltar, Malta, Scutari, Cape of Good Hope, Natal, Hong Kong, Singapore, Barbadoes, Bermuda, Halifax, two in Jamaica and four in Ceylon.

When these stations were first established, the results (if I may judge of the Colonial stations by the English ones) were not of much value. Latterly, however, I believe that a rigorous reorganisation has been carried out, and the results consequently have been raised in value. I hope that the Department will call upon the officers in charge for full reports and details as to the arrangement and locality in which the instruments are placed. At present nothing is given but

the numerical values, and one cannot tell which are good stations and which are bad. The following table gives an epitome of the results :—

Stations.	Temperature.					Mean Humidity.	Average Rainfall.
	Mean.	Absolute Max.	Absolute Min.	Absolute Range.	Mean daily Range.		
	°	°	°	°	°	0—100	in.
Scutari	58·7	103·6	13·0	90·6	18·0	71	29
Hong Kong	74·1	101·5	38·0	63·5	13·3	71	91
Jamaica, Up Park.	79·6	107·0	50·0	57·0	27·8	60	54
,, Newcastle	69·2	99·0	40·0	59·0	20·2	75	92
Bermuda	70·6	98·2	37·2	61·0	15·3	70	52
Halifax...	43·0	93·0	—15·7	108·7	21·3	71	54

On receipt of the request from the Council that I would prepare the present paper, I resolved that I would try to make it not merely the subject of an hour's talk, but a paper which should be creditable to myself, and worthy of appearing in our Transactions.

The first step was to sort out of my own library all works bearing upon the climate of the Colonies, and have lists made of those referring to each Colony. These lists, together with a circular letter, were sent to the Chief Secretary of twenty-eight Colonies. The circular (Appendix A and B) stated that I was preparing this paper, and anxious to render it an accurate guide to what was known respecting the climate of each Colony, and also to show what each was doing to obtain weather records at the present time. Similar circulars were sent to the Agents-General in this country.

I am glad to acknowledge the receipt of very considerable assistance in response to these applications : the details are epitomised in Appendix C.

Lastly, I give in a fourth Appendix (D), a list of the publications consulted for the preparation of this paper. Having a great dislike to incomplete work, I do not call this Appendix by any more dignified title than that of a "List of Works consulted," but it is by far the nearest approach to a complete catalogue of works on the climate of the British Colonies ever compiled. It includes nearly 350 separate works, the aggregate weight of which must be nearly a quarter of a ton. Perhaps the fact of having had to hunt through such a mass of materials entitles me to a little sympathy if my paper is somewhat heavy.

Having thus explained the materials collected, I shall without further preface state in as few words as I can what I have ascertained about each Colony, and I shall take them in the order of the tables in your hands, but with some additions and some omissions ; but roughly the order will be England to the Cape of Good Hope, thence to India, Ceylon, Australia, New Zealand, Fiji, the Falkland Isles, West Indies, and Canada.

ST. HELENA.

Observations were made at Longwood, 1,764 ft. above sea level, from 1841 to 1847 inclusive. The observations have been printed *in extenso*, but only the first five years have been discussed. The climate is a perfect type of an insular station. Mean temp. 61°·4, highest 77°·6, lowest 52°·0, range in five years only 25°·6, mean daily range 5°·6, mean humidity 87. The amount of rainfall is very doubtful, for the yearly totals range from 90½ in. to 19½ in., and simultaneous observations of two gauges only one mile apart showed that at the second station the fall was only one-sixth of that above stated. Apparently the average is about 40 in., but the amount is quite uncertain.

CAPE OF GOOD HOPE.

Three sets of observations have been made in this Colony. The first, extending from 1841 to 1846, were similar to those just mentioned at St. Helena, but, although the entire volume of tables was set up and printed more than twenty

years since, I believe, it was never published; at any rate I never saw a copy. This is a glaring, but unfortunately by no means unique waste of national money. The second set is the continuation of the same series at the Royal Observatory. The following are the principal results :—Mean temp. 61°·2, highest 97°·4, lowest 37°·7, range 59°·7, mean daily range 10°·3, mean humidity 75, mean rainfall 24 in. In the year 1859, while the Hon. Rawson W. Rawson was Colonial Secretary, a commission was appointed by the Government to obtain records of the climate of different parts of the Colony. About £400 worth of instruments were purchased, conveyed to the Cape, and distributed; and about a fourth of that sum was spent in collecting, reducing, and publishing the results. The temperatures above given seem fairly to represent the average climate of the Colony, but the extremes are greater at several stations than at the Royal Observatory. For example, temperatures exceeding 100° are reported from four stations, and at one—Amalienstein 110°·7 was reached on January 11, 1868, while sharp frosts occur at Aliwal North. The rainfall varies from 8 in. in Namaqualand to 40 in. near Cape Town. The average over the whole may perhaps be taken at 20 in. The work of this Commission seems to have been suspended between 1868 and 1875, and no results have been printed since the former year. A new Commission has recently been appointed, and the service is now being re-organised. Observations are also made at Cape Town by the Army Medical Department.

NATAL.

The Government of this Colony cannot be complimented upon what they have done for Meteorology. Very full records were kept by Dr. Mann, between 1858 and 1865, but it was, I believe, purely voluntary work on his part, the Government neither furnishing instruments nor assistant. A register is kept at the Botanic Gardens, Durban, but, I believe, therewith begins and ends the Governmental action in the matter. For a Colony aiming at extensive sugar production, it is suicidal not to have accurate knowledge of the rainfall. It is done in Mauritius, it is done in Jamaica, it has been thoroughly done in Barbadoes, but in Natal it has been entirely ignored. The only results I can get are for Pietermaritzburg, 2,100 ft. above the sea—Mean temp. 64°·6, highest 97°·8, lowest 29°·0, range 68°·8, mean daily range 18°·3, mean humidity 72, mean rainfall 30 in. The temp. is much higher on the coast—at Durban about 69°—and the rainfall larger, but, having only the record for one year, it is useless to quote it. Two private observers have taken the rainfall for some years: Mr. Wilkinson, at Ottawa Sugar Estate, 10 m. N. of Durban, has a mean of 42 in., and Mr. Lamport at Merebank, 8 miles S.W. of Durban, of 44 in., both of them small amounts for sugar cultivation.

MAURITIUS.

Considerable attention has been given to the climate of this island for many years. It has possessed a Meteorological Society for a quarter of a century, and what is still more important, that Society has had a hard-working secretary. The principal observations have been made in the vicinity of Port Louis, and give for it—Mean temp. 77°·1, highest 90°, lowest 62°·8, range 27°·2, daily range 6°·7, humidity 71, mean rainfall 56 in. The rainfall is, however, much greater in other parts of the island, reaching 100 or 150 in. in Moka, Grand Port, and some parts of Flacq.

BENGAL.

Before making any special remarks upon the climate of this province, I think it only right to state that, in my own opinion, few actions have been more judicious than that of the Indian Government, in at once acting upon the remarks made in the House of Commons by Mr. Egerton Hubbard, and creating one supreme and controlling Meteorological Department for the whole of India; nor do I fear contradiction when I assert that the present director, Mr. Blandford, is the fittest man for the post, not merely as the best meteorologist in India, but also as a firm administrator, a qualification of great importance. It would be ridiculous to attempt to give here either a summary of the meteorological work done in India, or of its results. I believe that the days when Indian rain gauges

were taken indoors and locked up every night are gone for ever, and that we may implicitly rely on Mr. Blandford, who knows what is necessary, doing all that is possible. However, I ought, perhaps, to give a few figures. At Calcutta the mean temp. is 79°, highest 106°, lowest 52°·7, range 53°·3, daily range 13°·2, humidity 76, mean rainfall 66 in. The rainfall of Bengal varies very greatly, ranging from 37 in. at Patna, to 527 in. at Cherra Poonjee; this last being, as far as is at present known, the wettest spot in the world.

(To be Continued).

GREENWICH EXTREME TEMPERATURES.

The extreme Shade Temperature of the month of April at the Royal Observatory, Greenwich, during the past 36 years.

Year.	Maximum.		Minimum.		Year.	Maximum.		Minimum.	
	deg.	date.	deg.	date.		deg.	date.	deg.	date.
1841	76·5	27	31·8	10	1859	79·0	6	25·3	1
1842	73·7	24	28·0	5	1860	65·0	30	28·2	11
1843	70·8	20	27·2	11	1861	63·5	12	26·8	21
1844	74·9	26	33·4	7	1862	75·0	25	26·7	13
1845	70·3	24	29·5	6	1863	69·3	20	28·3	1
1846	63·0	12	33·3	20	1864	73·8	20	33·4	13
1847	63·8	12	23·0	16	1865	81·5	27	31·9	2
1848	74·6	3	30·3	27	1866	79·0	27	34·2	5, 30
1849	64·3	30	26·8	18	1867	64·8	19, 23	30·5	1
1850	66·9	7	34·0	29	1868	68·9	30	28·9	12
1851	64·1	17	28·6	6	1869	79·1	14	29·3	2
1852	74·7	14	26·7	10	1870	78·7	20	26·0	4
1853	62·0	4	32·3	25	1871	66·5	12	29·1	7
1854	77·5	20	28·3	25	1872	69·9	12	29·6	20
1855	72·8	16	25·9	2	1873	76·8	15	28·7	26
1856	73·0	25	30·6	21	1874	79·7	23	30·5	30
1857	69·0	19	28·2	24	1875	71·5	30	27·8	25
1858	76·0	16	27·2	2	1876	70·2	8	29·2	12

Extremes in 1877, Max. : 66°·0 on 4th ; Min. : 32°·1 on 20th.

	Year.	Max.	Date.	Min.	Date.	Year.
Means of 36 years	...	71·7	19	29·1	13	...
Highest	1865	81·5	27	34·2	5 30	1866
Lowest.....	1853	62·0	4	23·0	16	1847
Range	...	19·5	...	11·2	...	...

EDWD. MAWLEY.

Addiscombe, May 4th, 1877.

APRIL, 1877.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·59	+ 1·46	·66	9	16	64·0	4	33·4	20	0	0
II.		Maidstone (Hunton Court)	2·57	...	·59	8	14	...	...	...	...	...	...
,,		Selborne (The Wakes)	3·43	+ 1·93	·44	9	19	57·8	22	28·7	20	4	7
III.		Hitchen	3·31	+ 2·31	·75	4	18	59·0	4	28·0	19	6	...
,,		Banbury	2·64	+ 1·48	·45	9	19	60·0	22	30·0	20	4	...
IV.		Bury St. Edmunds (Culford)	2·29	+ 1·54	·48	8	12	61·0	20	28·0	19	4	6
,,		Norwich (Sprowston)	...	...	...	...	...	...	...	...	...	...	...
V.		Bridport	3·90	+ 2·42	·72	15	15	64·0	21	30·0	20	2	...
,,		Barnstaple	3·82	+ 1·81	1·10	20	16	61·0	26*	32·5	20	...	...
,,		Bodmin	5·67	+ 3·97	2·16	15	18	59·0	11	35·0	20	0	1
VI.		Cirencester	3·32	+ 2·03	·70	4	18	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	2·34	+ 1·19	·51	4	17	57·0	22†	30·0	20	2	10
,,		Tenbury (Orleton)	3·01	+ 1·47	·81	4	19	61·0	22	28·0	20	1	6
VII.		Leicester (Belmont Villas)	3·07	...	·87	9	17	61·0	20	33·0	25	...	...
,,		Boston	3·19	+ 2·22	·57	9	18	64·0	20	33·0	12	0	...
,,		Grimsby (Killingholme)	3·33	...	·68	22	19	58·0	14	33·0	2, 20	0	...
,,		Mansfield	2·90	...	·71	9	22	64·9	22	27·5	27	2	2
VIII.		Manchester	...	...	...	...	...	...	...	...	...	...	...
IX.		York	3·53	+ 2·43	·73	22	13	58·0	4	29·0	20	3	...
,,		Skipton (Arncliffe)	4·33	+ 1·29	·63	12	22	...	...	...	...	...	...
X.		North Shields	3·53	+ 2·22	·82	9	18	53·0	4	30·0	20	3	8
,,		Borrowdale (Seathwaite)	5·43	— 1·47	1·68	3	16	...	...	...	...	...	...
XI.	WALES.	Cardiff (Crockherbtown)	2·90	...	·52	20	20	61·0	10	33·0	20	0	...
,,		Haverfordwest	5·92	+ 4·06	1·11	20	15	59·9	14	31·5	19	1	10
,,		Aberdovey	2·54	...	·50	21	16	68·0	10	28·0	17	3	...
,,		Llandudno	2·60	+ 1·10	·48	8	15	59·8	22	34·5	20	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	2·93	+ 1·26	·78	4	13	56·7	20	28·5	11	8	9
,,		Hawick (Silverbut Hall)	3·39	...	1·27	9	15	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	...	...	...	...	...	...	...	...	...	...	...
XV.		Castle Toward	3·80	+ 1·30	·98	23	12	55·0	7,19	26·0	11	14	...
XVI.		Mull (Quinish)	...	...	...	...	...	...	...	...	...	...	...
,,		St. Andrews (Cambo Ho.)	2·55	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	3·79	...	·41	3	11	...	...	...	...	...	...
XVII.		Braemar	1·93	+ ·53	·50	9	12	53·0	19	19·8	12‡	13	24
,,		Aberdeen	3·03	...	·74	10	13	51·7	4	29·5	12	5	9
XVIII		Gairloch	1·45	...	·39	3	8	...	...	...	...	...	...
,,		Portree	1·77	— 3·50	·39	2	10	...	...	...	...	...	...
,,		Inverness (Culloden)	1·88	+ ·31	1·06	11	13	56·0	4	27·2	18	9	16
XIX.		Helmsdale	2·16	...	1·08	10	11	...	...	...	...	...	...
,,		Sandwick	1·44	-- ·30	·31	3	11	51·5	4	28·3	14	5	11
XX.	IRELAND.	Caherciveen Darrynane Abbey	6·34	...	·80	7	23	...	...	...	...	...	...
,,		Cork	6·45	...	1·25	27	21	...	...	...	...	...	...
,,		Waterford	5·85	+ 3·62	1·58	15	22	61·0	21	30·0	24	1	...
,,		Killaloe	3·55	+ 1·42	·96	22	21	65·0	11	29·0	24	3	...
XXI.		Portarlington	3·56	+ 1·54	·58	21	28	59·0	14	34·0	23	0	...
,,		Monkstown, Dublin	5·08	+ 3·44	1·17	15	19	58·0	1	31·0	20	4	4
XXII.		Galway	3·34	...	·68	11	20	63·0	11‡	31·0	6	2	...
,,		Ballyshannon	1·77	...	·31	5	14	...	...	...	...	...	...
XXIII		Waringstown	3·76	...	1·16	8	18	58·0	22	29·0	23	7	12
,,		Edenfel (Omagh)	1·92	...	·49	8	17	57·0	25	28·0	18§	8	...

* And 27. † 23. ‡ 14 § 22.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON APRIL.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

SELBORNE.—Prevailing wind S.W. till the middle of the month, then variable, last week N.E.; R measured on 81 days this year, January 1st to April 30th. TS on 11th, extremely dark 3.30 to 4.30 p.m., with H and R; frost on the grass on 13th; cuckoo first heard on that day, and the first swallow seen on the 14th; R, H and T at 2.30 p.m. on 23rd.

HITCHEN.—Terrific TS and H on 4th.

BANBURY.—High winds on 15th, 16th and 17th; T on 4th, 22nd and 23rd; hawthorn bursting at the beginning of the month, and in leaf at the end; the latter half of the month unusually cold, with E. winds.

CULFORD.—T on 4th, 6th, and 7th, with hailstorms on the two latter days and on the 17th; high wind on 15th and 16th. The weather during the entire month has been cold, N.E. winds having prevailed from the 12th until the end of the month; max. temp. was 61°, the min. 28°, and the mean 44°·2. The song of the nightingale was heard as early as the 5th, but has been silent ever since, and the cuckoo has not yet been heard, nor a swallow seen.

BODMIN.—Mean temp. of the month 51°.

SHIFNAL.—A wet, cold, ungenial spring; R daily, with five exceptions, till the 24th, from which time to the close it was dry with wind as before, from N. or N.E; only four days (2nd, 10th, 22nd and 23rd) when the temp. was above 55°; only two nights with frost above the grass, whereas there was frost on grass on ten nights. A single distant clap of T in S.W. at 4.30 p.m. on 10th, no R; more T again, with R, at the same hour, on the 22nd, the wind each time shifting to S.W., afterwards returning to its old point N.E. Willow-wren arrived on 20th; ring dove first cooed on 22nd; cuckoo first heard, and swallow first seen, on 27th.

ORLETON.—A very cold, ungenial month, with a rainfall above the average, and very little sunlight; up to the 24th there were only five days without measurable R; on that day a dry, cold wind set in from the N.E. and continued. The mean temp. of the month was about 4½° below the average, but it was uniform, with only a few frosty nights. The cuckoo was generally heard about the 26th; the chiff-chaff was first seen on the 4th, the white-throat on the 12th. Plum trees were in full blossom on the 8th, and damson about the 13th. No T heard or L seen.

LEICESTER.—A very heavy R during the night of the 9th (·87) the max. fall of the month; a severe TS on the evening of the 10th; T and L incessant from 7.15 to 8 p.m.; also a slight TS on evening of 22nd. Temp. generally low for the season, only two days above 60°; mean max. 53°·6; mean min. 39° 2; mean temp. 44°·9. Much E. and N.E. wind during the latter half of the mont, during which time vegetation has made very little progress.

GRIMSBY.—At the beginning of the month the wind backed frequently. The whole month was cold, wet, and gloomy, with E. wind prevailing. The wettest (3·33 in.) April for many years; TS with vivid flashes on 4th; L at 1 p.m. and T at 4 p.m on 5th; distant T at 3.30 p.m. on 23rd; chiff-chaff heard on 11th; lesser white-throat seen on 12th; swallow seen on 15th, and redstart on 22nd; cuckoo heard on 27th.

MANSFIELD.—The month has been cold and dull, and in consequence vegetation is very backward; mean temp., 9 a.m., 44°·2, which is 8°·1 below the five years' average; the highest recorded temp. is 64° 9, on the 22nd, and the lowest, 27°·5, on the 27th; heavy R, H and TS at 6 p.m. on 4th.

NORTH SHIELDS.—TS on 4th; solar halo on 12th and on 20th.

SEATHWAITE.—Only one day on which the fall reached 1·00 in.; only three on which half an inch fall.

WALES.

HAVERFORDWEST.—Hail of very large size and destructive to glass and tender vegetation on the 6th and 7th; the mountains were covered with S on the 4th; from the 7th to the 14th the weather was fine, mild, and dry, after which a very wet, stormy, and cold period set in continuing (except the interval 24th to 26th) to the end of the month. The blackthorn blossomed unusually this April; wind easterly during the greater part of the month; temp. below 40° on 16 nights; vegetation very backward.

ABERDOVEY.—A cold month on the whole; very stormy towards the close.

LLANDUDNO.—Hail showers at 1 p.m. and at 7.30 p.m. on 5th; a splendid double rainbow from 5 to 6 p.m on 7th; blackthorn in blossom on 11th; plane in leaf on 19th; apple trees in flower on 22nd; cuckoo heard on 28th; showery and unsettled for the first three weeks; weather dry and steady, with persistent E. winds from the 23rd; swallows seen on the 24th, and cuckoo heard on 28th. Rainfall an inch above the average, and temp. more than 2° below it.

SCOTLAND.

DUMFRIES.—A cold, ungenial month, the wind easterly, though light, nearly every day during the month; white frosts frequent, and S fell on three days; severe TS on 5th; mean temp. 41°·9, 2° or 3° below the average.

HAWICK.—The most unpropitious April for gardening or farming ever remembered; the strong cold E. wind which prevailed on 23 days had a most chilling effect on young lambs, and on vegetation; the hills have been either entirely white or piebald with S the whole month. The rainfall is an inch above the average. There was some T on the night of the 4th, and a heavy fall of S and R on the 9th. The cuckoo has not yet been heard, nor a swallow seen.

BRAEMAR.—A month of very low temp. throughout, with prevailing sharp N.E. winds. Hills still entirely covered with S; vegetation dormant.

ABERDEEN.—A month of cold, bleak, unseasonable weather, with an excess of rainfall, though on a smaller number of days; the heaviest rainfall here, fell as S on Deeside. Mean temp. 2°·4 below the 20 years' average, rainfall above it.

PORTREE.—A dry and very cold month, wind generally from N. or E.; frost nearly every day. Solar halo on four days, the one on 20th continued all day. Gale all day on 15th from the S.E. Pastures burnt up by the bright sunshine and the frosty nights. The driest April on record, except in 1873. Rainfall more than 3 in. under the average of the last 16 years.

CULLODEN.—L on night of 4th; frequent sharp frosts, S 2 inches deep on the Moor (400 ft. above sea level) on 23rd.

SANDWICK.—April has been very cold, stormy, and very dry since the 12th, so vegetation is very backward. There were gales on 1st, 5th, 15th, 16th, 21st, and 22nd, from 40 to 50 miles an hour, that on the 15th was even 60 miles an hour; ground white with S on 10th, 11th, 12th, 13th, but thawed during the day; aurora on 17th.

IRELAND.

DARRYNANE.—A wet, cold, ungenial month, and the wettest April registered here; the total fall (21·72 in.) for the four months is also in excess of the corresponding period since 1870, when my register begins.

WATERFORD.—Very heavy H for a short time on 5th. Fine meteor seen on 6th. Owing to the prevalence of S.E. and N.E. winds, and consequent low temp., vegetation is very backward; chesnuts partly nipped with the frost. Country greatly flooded, as much so as in the wettest part of the winter.

KILLALOE.—Scarcely any frost this month, but low temp. during the last week; very sharp E. and N.E. winds; vegetation much in advance of last year, but now checked by the E. wind.

MONKSTOWN.—An unusually wet April; the latter part of the month very dry and cold, with easterly winds.

BALLYSHANNON.—The month has been very favourable throughout for the agriculturist, though rather cold, with frequent showers in the first half of the month, and a prevailing E. and S.E. wind in the latter part, which has left the ground very dry.

WARINGSTOWN.—Very wet and cold. Spring backward, and labour very much behind what is usual; ground quite saturated.

EDENFEL, OMAGH.—A most backward and inclement month. Though the wind blew strong from the E. (usually a dry point) on 23 days, it was accompanied by cold R in the first half, and cold drought in the latter half of the month. Swallows appeared on the 8th, but left immediately, and have not yet returned. Hedges are still almost brown, and vegetation generally is a month late.

SUPPLEMENTARY TABLE OF RAINFALL IN APRIL, 1877.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see Met. Mag., Vol. XI., p. 28., but the list is under revision and further details will be given in a month or two.]

Div.	Station.	Total Rain.	Div.	Station.	Total Rain.
		in.			in.
II.	Acol	2·58	XI.	Llanfrechfa	4·56
,,	Hailsham	2·11	,,	Castle Malgwyn	3·31
,,	St. Lawrence, I. of W.	2·56	,,	Heyope	...
,,	Andover	2·05	,,	Carno	3·02
,,	Strathfield Turgiss	2·48	,,	Rhug, Corwen	2·50
III.	Addington Manor	3·04	,,	Port Madoc	3·64
,,	Oxford	1·96	XII.	Melrose	3·75
,,	Northampton	2·40	XIV.	Cessnock, Glasgow	3·21
,,	Cambridge	2·35	XV.	Gruinart	2·11
IV.	Sheering	2·47	XVII.	Keith	1·78
,,	Ipswich	1·96	XVIII.	Dalwhinnie	2·62
,,	Diss	1·75	,,	Auchnasheen	1·43
,,	Swaffham	2·39	,,	Springfield, Tain	1·35
V.	Compton Bassett	3·47	XX.	Skibbereen	...
,,	Dartmoor	9·16	,,	Glenville, Fermoy	5·70
,,	Teignmouth	6·42	,,	Tralee	3·27
,,	Langtree, Torrington	4·06	,,	Newcastle W., Limerick	3·41
,,	Cosgarne, St. Austell	5·02	,,	Kilrush	2·21
,,	Taunton	3·58	XXI.	Kilkenny	4·40
VI.	Bristol	3·14	,,	Kilsallaghan	4·29
,,	Sansaw	2·92	,,	Twyford, Athlone	3·72
,,	Cheadle	2·23	XXII.	Ballinasloe	3·25
VII.	Coston, Melton Mowbray	3·08	,,	Kylemore	5·77
,,	Bucknall	2·84	,,	Carrick on Shannon	2·28
VIII.	Walton, Liverpool	1·91	XXIII.	Rockcorry	2·25
,,	Broughton-in-Furness	2·37	,,	Warrenpoint	4·41
IX.	Stanley, Wakefield	2·97	,,	Carnlough, Larne	4·75
X.	Gainford	3·80	,,	Bushmills	1·72
,,	Shap	3·01	,,	Bunerana	1·95